IMAGE DISPLAY DEVICE

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Abstract

PURPOSE:To make nearly parallel luminous flux incident on the pupil of an observer and to display an image by providing >=1 light source which can be intensity- modulated, a wavefront curvature modulating means, a luminous flux deflecting means, an optical path element, and >=1 lens. CONSTITUTION:A data processing and control part 10 calculates display image data from position and shape information, lighting conditions, and view point position information on a display object in a virtual space to generate intensity modulating signals for light sources 11 - 13 of the primary colors, a control signal for a wavefront curvature modulating means 19, and a synchronizing signal for a luminous flux deflecting means 20. Projection light beams from the light sources are collimated by a collimator lens 14 into pieces of parallel luminous flux, which are multiplexed by wavelength selective mirrors 15 - 17 and made incident on an optical fiber through a focusing lens 14. The projection light is collimated by a collimator lens 14e into parallel luminous flux, the wavefront curvature modulating means 19 modulates the luminous flux wavefront curvature by utilizing the deformation of the convex surface shape of a piezoelectric plate, and a luminous flux deflecting means makes the luminous flux incident while varying the angle of incidence on the pupil of the observer through the three lenses and polygon mirror. At this time, the observer is given an optional natural feeling of stereoscopy.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Industrial Application]
this invention relates to the image display equipment which is the wide field of view and can also give a natural three-dimensional visual sense.
[Description of the Prior Art]
Conventionally, as quality image display equipment, usually, highly minute CRT is used and it is used for the display of CG, CAD, and various simulation results. By progress of image-data-processing technology, display quality of image is very good, for example, thing does not exist in an automobile design, a townscape check, etc., but ** also generates image data by computer based on a design data etc., and a realistic display is possible for it. Moreover, the various proposals also of the means which makes a three dimentional display possible by giving binocular parallax are made. For example, the picture for the object for left eyes and right eyes can be displayed by turns on CRT, an observer's liquid crystal shutter in sight can be opened and closed synchronizing with it, and binocular parallax can be given.
[Problem(s) to be Solved by the Invention]
However, with the above-mentioned technology, there is a fault that an absolute-size display cannot be performed, in many display objects. In designs, such as furniture and an automobile, a townscape check, etc., a fractional dimension also essentially becomes important in accordance with the color of a display, and texture. Usually, the size of CRT is several 10cm and the absolute-size display of the aforementioned object is impossible. Although the absolute-size display of a less than several m object will be possible if a projection screen etc. is used, equipment is enlarged and will become very expensive.
On the other hand, there is a problem also about a 3-dimensional three dimentional display.
Since the object positions (=CRT tubular surface) decided by the object position decided by binocular parallax and focus regulation differ, there is an unnatural feeling, and defatigation of an observer is also large. In addition, it is inadequate also in respect of the wide field of view required for a natural stereoscopic vision difference, and the limitation was in the performance as 3-dimensional three-dimentional-display equipment.
The place which is made in order that this invention may solve the trouble mentioned above, compounds the same flux of light as carrying out incidence to an observer's pupil when a display object exists really, is characterized by giving a visual sense by irradiating an observer's eyeball, and is made into the purpose is to offer the small image display equipment which is the wide field of view and gives a natural cubic effect.
[The means for solving a technical problem]
In order to attain this purpose the image display equipment of this invention the one or more light sources in which intensity modulation is possible, and abbreviation which fabricated this light source output and was obtained -- with a wave-front curvature modulation means to modulate the wave-front curvature of the parallel flux of light The flux of light deflection means which deflect the propagation direction of the flux of light, and the optical-path element which enables the flux of light to spread between the aforementioned components, the abbreviation 1 each of the degree of incident angle, wave-front curvature, and intensity was modulated by each aforementioned component of whose -- it has the optical system for making the parallel flux of light into a desired light beam configuration, and carrying out incidence to an observer's pupil
[Function]
the output light from the light source with which intensity modulation of the image display equipment of this invention which has the above-mentioned composition was carried out -- abbreviation -- it fabricates to the parallel flux of light, and by the wave-front curvature modulation means, it is set as the value of a request of the wave-front curvature of the aforementioned flux of light, and incidence is carried out to an observer's pupil At this time, an observer acquires a

visual sense as if the luminescent spot was in a distance equal to wave-front radius of curvature on the direction extension wire of flux of light incidence. If optical intensity and wave-front curvature are modulated at the same time it sweeps the degree of incident angle to the pupil of the aforementioned flux of light by flux of light deflection means, arbitrary natural solid visual senses can be given to an observer.

[Example]

Hereafter, one example which materialized this invention is explained with reference to a drawing.

Views 1 are the whole image display equipment block diagram of this example, and a block diagram of 2nd [**] view wave-front curvature modulation means, and a view 3 is a block diagram of flux of light deflection means.

Composition and an operation are explained according to a drawing. In data processing and a control section 10, display image data are calculated from the position configuration information on the three-dimensional display object in a virtual space, and lighting conditions and view positional information, and the intensity-modulation signal over the R light source 11, the G light source 12, and illuminant B and the control signal to a wave-front curvature modulation means, the synchronizing signal to flux of light deflection means, etc. are generated. The algorithm of these various calculation is regularly used in the CG field, and omits explanation here. After the outgoing radiation light from R, G, and B each light sources 11, 12, and 13 is fabricated by the abbreviation parallel flux of light with collimate lenses 14a-14c, it is multiplexed by the wavelength-selection nature mirrors 15, 16, and 17, and incidence of it is carried out to an optical fiber 18 by focal lens 14d. the outgoing radiation light from the other end of this optical fiber 18 -- collimate lens 14e -- abbreviation -- it is changed into the parallel flux of light, and incidence is carried out to the wave-front curvature modulation means 19 With this wave-front curvature modulation means 19, a modulation is added to the wave-front curvature (** parallelism) of the aforementioned incoming beams according to the aforementioned data processing and the control signal from a control section 10. The aforementioned wave-front curvature modulation means 19 consists of a piezo-electric board 51 attached in the holder 50, and electrodes 52a and 52b (the reflective film 53 and laminating). If control signal voltage is impressed to Electrodes 52a and b, the piezo-electric board 51 by which polarization was carried out suitably will deform in the shape of a convex. Consequently, the wave-front curvature of the flux of light changes before and after the reflection in the reflective film 53.

Incidence of the outgoing beam from the aforementioned wave-front curvature modulation means is carried out to the flux of light deflection means 20. The flux of light is irradiated in the flux of light deflection means 20, changing an incident angle to an observer's pupil by three lens 101 a-c and the polygon mirror 102. Flux of light deflection means already carry out lot installation (illustration ellipsis), and are swept two-dimensional.

2 system successive installation possession of the above optical system is carried out, and the flux of light is supplied to an observer's both eyes.

In addition, about each component of the above-mentioned example, various kinds of deformation is possible. If the light source is made into the shape of-dimensional [1] or two-dimensional array, corresponding to it, simplification or improvement in the speed of -dimensional[1]-izing etc. is possible for flux of light deflection means. As a wave-front curvature modulation means, if a low speed is permitted, a moving lens can be used. Moreover, when improvement in the speed is more required, the waveguide of a refractive-index distribution pattern is formed with material with the electro-optical effect, and form of modulating the refractive-index distribution configuration with an electric means can also be adopted. On the other hand, as flux of light deflection means, use of acousto-optic-effect deflecting system is also possible.

[Effect of the Invention]

Since it has the composition of having prepared a wave-front curvature modulation means and flux of light deflection means into the optical path from the light source in which intensity modulation is possible to an observer according to this invention so that clearly from having explained in full detail above, the flux of light with the same intensity as the case where a display body exists really, the direction of incidence, and wave-front curvature can be directly irradiated to an observer's pupil through optical system, therefore a very natural three-dimensional visual sense can be given to an observer by the wide field of view.

[Translation done.]

* NOTICES *

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CLAIMS

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(57) [Claim(s)]
[Claim 1] Image display equipment characterized by providing the following The one or more light sources in which intensity modulation is possible abbreviation which fabricated this light source output and was obtained -- a wave-front curvature modulation means to modulate the wave-front curvature of the parallel flux of light Flux of light deflection means which deflect the propagation direction of the flux of light abbreviation each of the degree of incident angle, wave-front curvature, and intensity was modulated by whose optical-path element which enables the flux of light to spread between the aforementioned components and each aforementioned component -- the optical system for making the parallel flux of light into a desired light beam configuration, and carrying out incidence to an observer's pupil
[Claim 2] The aforementioned flux of light deflection means are image formation equipment given in the 1st term characterized by the ability to deviate two-dimensional.
[Claim 3] It is image display equipment given in the 1st term characterized by the ability to carry out the abbreviation rectangular cross of the aforementioned flux of light deflection means in the aforementioned light source array direction, and deviate [for the aforementioned light source to be one-dimensional array-like, and] to one dimension.
[Claim 4] Image display equipment given in either the 1st term which makes a bundle the aforementioned wave-front curvature modulation means and flux of light deflection means, and is characterized by connecting between these and the aforementioned light sources by the optical fiber, or the 3rd term.
[Claim 5] The aforementioned wave-front curvature modulation means is image display equipment given in either the 1st term characterized by being an adjustable focal mirror using piezoelectric material, or the 4th term.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
The example which materialized this invention up to the view 3 is shown from a view 1, a view 1 is the whole equipment block diagram, a view 2 is a block diagram of a wave-front curvature modulation means, and a view 3 is a block diagram of flux of light deflection means.
10 [.. G light source, 13 / .. Illuminant B, 14 / .. A lens, 15-17 / .. A wavelength-selection nature mirror, 18 / .. An optical fiber, 19 / .. A wave-front curvature modulation means 20 / .. Flux of light deflection means] .... Data processing and a control section, 11 .. R light source, 12

[Translation done.]

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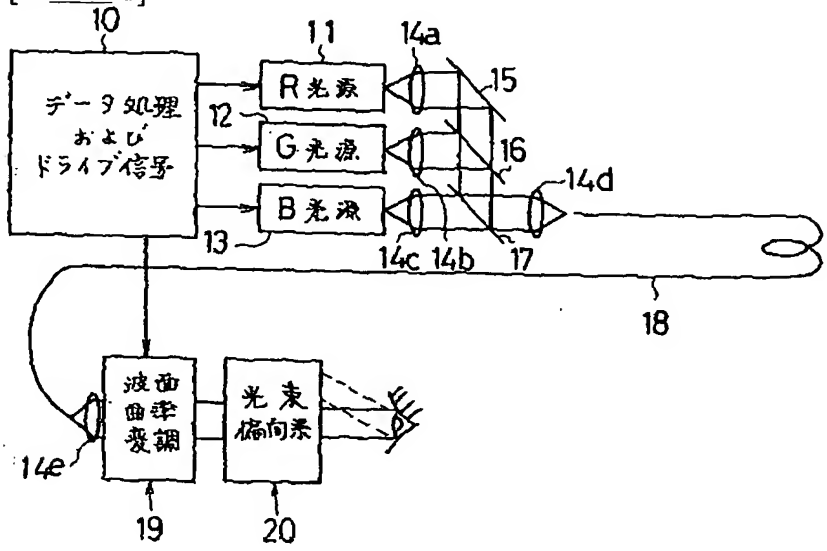
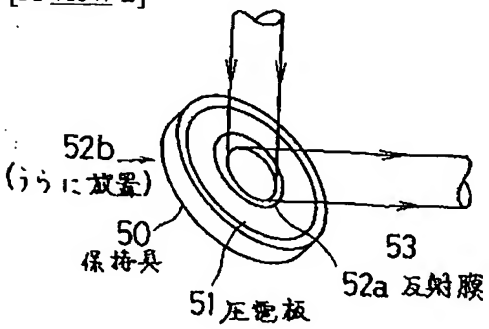
DRAWINGS

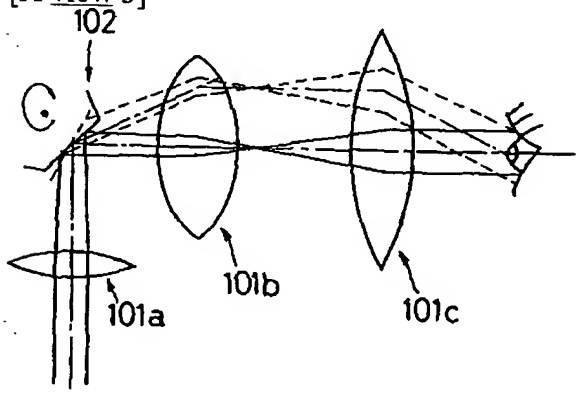
[A view 1]



[A view 2]



[A view 3]



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26/10		26/10	Ｚ
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(56)参考文献　特開　昭49－45630（ＪＰ，Ａ）

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G02B　27/02
G02B　26/10

(54)【発明の名称】　画像表示装置

(57)【特許請求の範囲】

【請求項１】強度変調が可能な、ひとつ以上の光源と、該光源出力を成形して得られた略平行な光束の波面曲率を変調する波面曲率変調手段と、
光束の伝搬方向を偏向する光束偏向手段と、
前記構成要素間を光束が伝播することを可能とする光路要素と、
前記各構成要素により入射角度、波面曲率、強度の各々が変調された略平行な光束を、所望の光ビーム形状にし、観察者の瞳孔に入射するための光学系と、
を具備したことを特徴とする画像表示装置。

【請求項２】前記光束偏向手段は２次元的に偏向可能であることを特徴とする第１項記載の画像形成装置。

【請求項３】前記光源が１次元配列状であり、前記光束偏向手段は前記光源配列方向に略直交して、１次元に偏向可能なことを特徴とする第１項記載の画像表示装置。

【請求項４】前記波面曲率変調手段と光束偏向手段とを一まとまりにし、これらと前記光源との間を光ファイバによって接続したことを特徴とする第１項または第３項のいずれかに記載の画像表示装置。

【請求項５】前記波面曲率変調手段は、圧電材料を利用した可変焦点ミラーであることを特徴とした第１項乃至第４項のいずれかに記載の画像表示装置。

【発明の詳細な説明】

［産業上の利用分野］

本発明は、広視野でかつ、自然な立体的視覚をも与え得る画像表示装置に関するものである。

［従来技術］

従来、高品質画像表示装置としては、通常、高精細CRTを利用し、コンピュータグラフィックス、CAD、各種シ

1

ミュレーション結果の表示に使用されている。画像データ処理技術の進展により、表示画質は極めて良質であり、例えば、自動車デザイン、都市景観チェック等において実物が存在せずとも、設計データ等にもとづいてコンピュータによって画像データを生成し、リアリスティックな表示が可能となっている。また、両眼視差を与えることで立体表示を可能とする手段も各種提案されている。例えば、CRT上に左眼用、右眼用の画像を交互に表示し、それと同期して観察者の眼前の液晶シャッタを開閉し、両眼視差を与えることができる。

［発明が解決しようとする課題］

しかしながら、前述の技術では、多くの表示対象物において、実寸表示ができないという欠点がある。家具、自動車等のデザイン、都市景観チェックなどにおいては、表示の色，質感にあわせて表示寸法も本質的に重要となる。通常CRTの寸法は数10cmであり、前記対象物の実寸表示は不可能である。投影スクリーン等を用いれば数m以内の対象物の実寸表示は可能となるが、装置は大型化し、極めて高価なものとなる。

一方、３次元立体表示に関しても問題がある。

両眼視差で決まる対象位置とピント調節で決まる対象位置（＝CRT管面）とが異なるため不自然感があり、また観察者の疲労も大きい。加えて自然な立体視差に必要な広視野の点でも不十分であり、３次元立体表示装置としての性能に限界があった。

本発明は、上述した問題点を解決するためになされたものであり、表示対象物が実在した場合に観察者の瞳孔に入射するのと同一の光束を合成し、観察者の眼球に照射することで視覚を与えることを特徴とし、その目的とするところは、広視野でかつ自然な立体感を与える小型な画像表示装置を提供することにある。

［課題を解決するための手段］

この目的を達成するために本発明の画像表示装置は、強度変調が可能な、ひとつ以上の光源と、該光源出力を成形して得られた略平行な光束の波面曲率を変調する波面曲率変調手段と、光束の伝搬方向を偏向する光束偏向手段と、前記構成要素間を光束が伝播することを可能とする光路要素と、前記各構成要素により入射角度、波面曲率、強度の各々が変調された略１平行な光束を、所望の光ビーム形状にし、観察者の瞳孔に入射するための光学系とを備えている。

［作用］

上記の構成を有する本発明の画像表示装置は、強度変調された光源からの出力光を略平行な光束に成形し、波面曲率変調手段によって、前記光束の波面曲率を所望の値に設定し、観察者の瞳孔に入射する。この時、観察者は、光束入射方向延長線上で、波面曲率半径に等しい距離に輝点があるかのような視覚を得る。光束偏向手段によって前記光束の瞳孔への入射角度を掃引すると同時に光強度，波面曲率を変調すれば任意の自然な立体視覚を観察者に与えることができる。

2

［実施例］

以下、本発明を具体化した一実施例を図面を参照して説明する。

第１図は本実施例の画像表示装置の全体構成図、第２図波面曲率変調手段の構成図、第３図は光束偏向手段の構成図である。図面に従って構成および作用を説明する。データ処理および制御部10では、仮想空間における３次元表示対象物の位置形状情報と照明条件、視点位置情報から表示画像データを計算し、Ｒ光源11、Ｇ光源12、Ｂ光源に対する強度変調信号および波面曲率変調手段への制御信号、光束偏向手段への同期信号等を発生する。該各種計算のアルゴリズムはコンピュータグラフィックス分野で常用されているものであり、ここでは説明を省略する。R,G,B各光源11,12,13からの出射光は、コリメートレンズ14a～14cによって略平行光束に成形された後、波長選択性ミラー15,16,17によって合波され、フォーカスレンズ14dによって光ファイバ18に入射される。該光ファイバ18の他端よりの出射光は、コリメートレンズ14eによって略平行な光束に変換され、波面曲率変調手段19に入射される。該波面曲率変調手段19では、前記データ処理および制御部10からの制御信号に従って、前記入射光束の波面曲率（□平行度）に変調を加える。前記波面曲率変調手段19は、保持具50に取り付けられた圧電板51、電極52a,52b（反射膜53と積層）からなる。電極52a,bに制御信号電圧を印加すると適当に分極された圧電板51は凸面状に変形する。その結果、反射膜53における反射の前後で光束の波面曲率が変化する。

前記波面曲率変調手段からの出射光束は光束偏向手段20へ入射される。光束偏向手段20においては、３箇のレンズ101a～ｃとポリゴンミラー102によって観察者の瞳孔へ入射角を変化させつつ光束を照射する。光束偏向手段は、もう一組設置し（図示省略）２次元的に掃引する。

以上の光学系を２系列設具備し、観察者の両眼に光束を供給する。

なお、上記実施例の各構成要素については、各種の変形が可能である。光源を１次元あるいは２次元配列状にすれば、それに対応して光束偏向手段は１次元化等の簡略化あるいは高速化が可能である。波面曲率変調手段としては、低速が許容されれば可動レンズを使用できる。また、より高速化が必要な場合は、屈折率分布型の導波路を電気光学効果のある材料で形成し、その屈折率分布形状を電気的手段で変調するという形式も採用できる。一方、光束偏向手段としては、音響光学効果偏向器の利用も可能である。

［発明の効果］

以上詳述したことから明らかなように、本発明によれば、強度変調可能な光源から観察者までの光路中に、波面曲率変調手段と光束偏向手段とを設けた構成となって

3

いるために、表示物体が実在した場合と同一強度、入射方向、波面曲率をもった光束を光学系を介して観察者の瞳孔へ直接照射することができ、従って、広視野で極めて自然な立体的視覚を観察者に与えることができる。

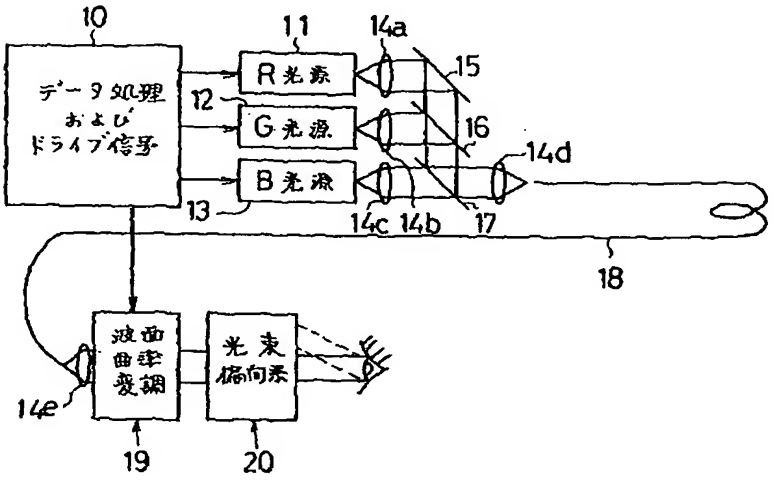
【図面の簡単な説明】

第１図から第３図までは本発明を具体化した実施例を示すもので、第１図は装置全体構成図であり、第２図は波面曲率変調手段の構成図であり、第３図は光束偏向手段の構成図である。

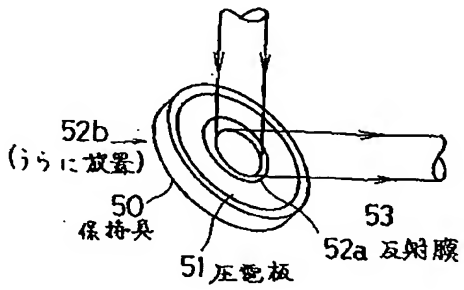
4

10……データ処理および制御部、11……Ｒ光源、12……Ｇ光源、13……Ｂ光源、14……レンズ、15～17……波長選択性ミラー、18……光ファイバ、19……波面曲率変調手段、20……光束偏向手段。

【第１図】



【第２図】



【第３図】